ZooKeys 953: 137–159 (2020)
doi: 10.3897/zookeys.953.50881
https://zookeys.pensoft.net

CHECKLIST

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

A conservation checklist of the amphibians and reptiles of the State of Mexico, Mexico with comparisons with adjoining states

Julio A. Lemos-Espinal[1], Geoffrey R. Smith[2]

1 *Laboratorio de Ecología-UBIPRO, FES Iztacala UNAM, Avenida los Barrios 1, Los Reyes Iztacala, Tlalnepantla,edo. de México, 54090, México* **2** *Department of Biology, Denison University, Granville, Ohio 43023, USA*

Corresponding author: Julio A. Lemos-Espinal (lemos@unam.mx)

Academic editor: Johannes Penner | Received 6 February 2020 | Accepted 19 June 2020 | Published 27 July 2020

http://zoobank.org/B7759B78-67B3-4F23-AE4C-79E929DC8855

Citation: Lemos-Espinal JA, Smith GR (2020) A conservation checklist of the amphibians and reptiles of the State of Mexico, Mexico with comparisons with adjoining states. ZooKeys 953: 137–159. https://doi.org/10.3897/zookeys.953.50881

Abstract

The State of Mexico has a unique combination of geographic characteristics and topography that promotes a high biodiversity. Unfortunately, continued human population growth of the metropolitan areas of Mexico City and Toluca have degraded the environment of the State of Mexico, which threatened its wildlife. An updated checklist of the amphibians and reptiles of the State of Mexico is provided and their conservation status summarized. The State of Mexico has 49 species of amphibians and 101 species of reptiles. The majority of the amphibians (73.5%) and reptiles (70.3%) found in the State of Mexico are endemic to Mexico. Of the amphibian and reptile species in the State of Mexico, 20.1% are IUCN listed (i.e., Vulnerable, Near Threatened, or Endangered), 18.4% are placed in a protected category by SEMARNAT (excluding NL and Pr, this last category is equivalent to the LC category of IUCN), and 34.9% are categorized as high risk by the EVS. The importance of forested habitats for the protected amphibians and reptiles in the State of Mexico suggest that management of these habitats to maintain or expand them needs to be considered.

Keywords

checklist, crocodilians, frogs, herpetofauna, lizards, salamanders, snakes, turtles

Copyright *J.A. Lemos-Espinal, G.R. Smith.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Introduction

Although relatively small, the State of Mexico bears unique geographic characteristics that combined with its topography create conditions that promote a high level of biodiversity. Unfortunately, these same conditions along with the continued human population growth of the metropolitan area of Mexico City and the city of Toluca have created high water and air pollution levels, deforestation, habitat fragmentation, and low water availability, which threaten the wildlife of this state (Rodríguez Romero et al. 2008; Flores-Villela et al. 2010). For example, atmospheric water in the Valley of Mexico contains heavy metals that are detectable and exceed regulatory limits when condensed (Bautista-Olivas et al. 2014). This is especially important for amphibians and reptiles, which are represented in the State of Mexico by a unique assortment of species. Central Mexico, including the State of Mexico, contains several areas of high endemicity for the herpetofauna of Mexico and as such is very important to the conservation of the Mexican herpetofauna (Flores-Villela et al. 2010).

Here, we provide an updated checklist of the amphibians and reptiles documented in the State of Mexico. We also summarize the conservation status of these species with the goal of determining if there are particular taxa of conservative concern in the State of Mexico. In addition, we consider the overlap in species between the State of Mexico and its neighboring states.

Physiographic characteristics of the state

The State of Mexico is the most populous, as well as the most densely populated state in Mexico. It is located in south-central Mexico, in the highest part of the Mexican Altiplano, between 18°22'0.84"N and 20°17'9.24"N, and 100°36'46.8"W and 98°35'48.84"W (Fig. 1). It is bordered by the states of Querétaro and Hidalgo to the north, Morelos and Guerrero to the south, Michoacán to the west, Tlaxcala and Puebla to the east, and surrounds Mexico City on three sides (west, north, and east). The state is relatively small (22,351 km^2) and is the seventh smallest Mexican state, representing 1% of the total surface territory of Mexico (modified from Wikipedia – https://en.wikipedia.org/wiki/State_of_Mexico – accessed 21 November 2019).

The topography of the state is highly variable, with the highest mountains in the extreme eastern part of the state along the border with Puebla (Popocatépetl 5,380 m altitude, Iztaccíhuatl 5,203 m, Monte Tláloc 4,120 m), and in the central part of the state (Nevado de Toluca 4,643 m), as well as rugged intermontane valleys, hills and plains, with altitudes ranging from 300 m near the border with Guerrero to 5,380 m on the top of the Popocatépetl Volcano (Fig. 2). The State of Mexico contains two physiographic provinces: a) Eje Neovolcánico, and b) Sierra Madre del Sur (Fig. 3; modified from INEGI 2017). The Eje Neovolcánico comprises most of the state, occupying the central, northern and eastern portions of the state. This province is divided into three sub-provinces: a) Lagos y Volcanes de Anáhuac, which occupies most of the central, north, and east portions of the state, and includes the northern part of the

Figure 1. Map of Mexico with the State of Mexico shown in red (modified from INEGI, 2018a).

Metropolitan Zone of Mexico and the city of Toluca. b) Mil Cumbres, a thin strip running from north to south and lying between the sub-provinces of Lagos y Volcanes de Anáhuac and Depresión del Balsas, and eastern Michoacán. c) Planicies y Sierras de Querétaro e Hidalgo, a small portion at the northern end of the state that borders Querétaro and Hidalgo. The Sierra Madre del Sur comprises the southwestern corner of the state along its border with Guerrero and western-northwestern Morelos, and is divided into two sub-provinces: a) Depresión del Balsas, which is bordered by northern Guerrero, and b) Sierras y Valles Guerrerenses, which is a small area bordering northern Guerrero and western-northwestern Morelos (Fig. 3).

The State of Mexico has a variety of vegetation types (Fig. 4; modified from INEGI 2017). Agricultural Areas that occupy 54.61% of the state's surface area, and are found mainly in the central, northern, and eastern parts of the state, occupying most of the province of the Eje Neovolcánico. Woodlands cover 27.22% of the state's surface area, and are scattered at the higher elevations of the Eje Neovolcánico province, especially the western foothills of the Popocatépetl and Iztaccíhuatl volcanoes, the Sierra de las Cruces – Sierra del Ajusco complex, the area surrounding the Nevado de Toluca Volcano, and most of the Mil Cumbres Subprovince. Woodlands include Oak Forests which are distributed between 1,600 and 2,400 meters above sea level; Pine-Oak Forest, which develops above 2,400 meters altitude; and Pine Forest, which develops in the highest elevations of the state's mountains. At the highest elevations, this forest is surrounded by padded grasses including *Mülhenbergia rigida*, *Stipa ichu*, and *Bouteloa gracilis* among others. Grasslands, covering 12.15% of state's surface area, occur in

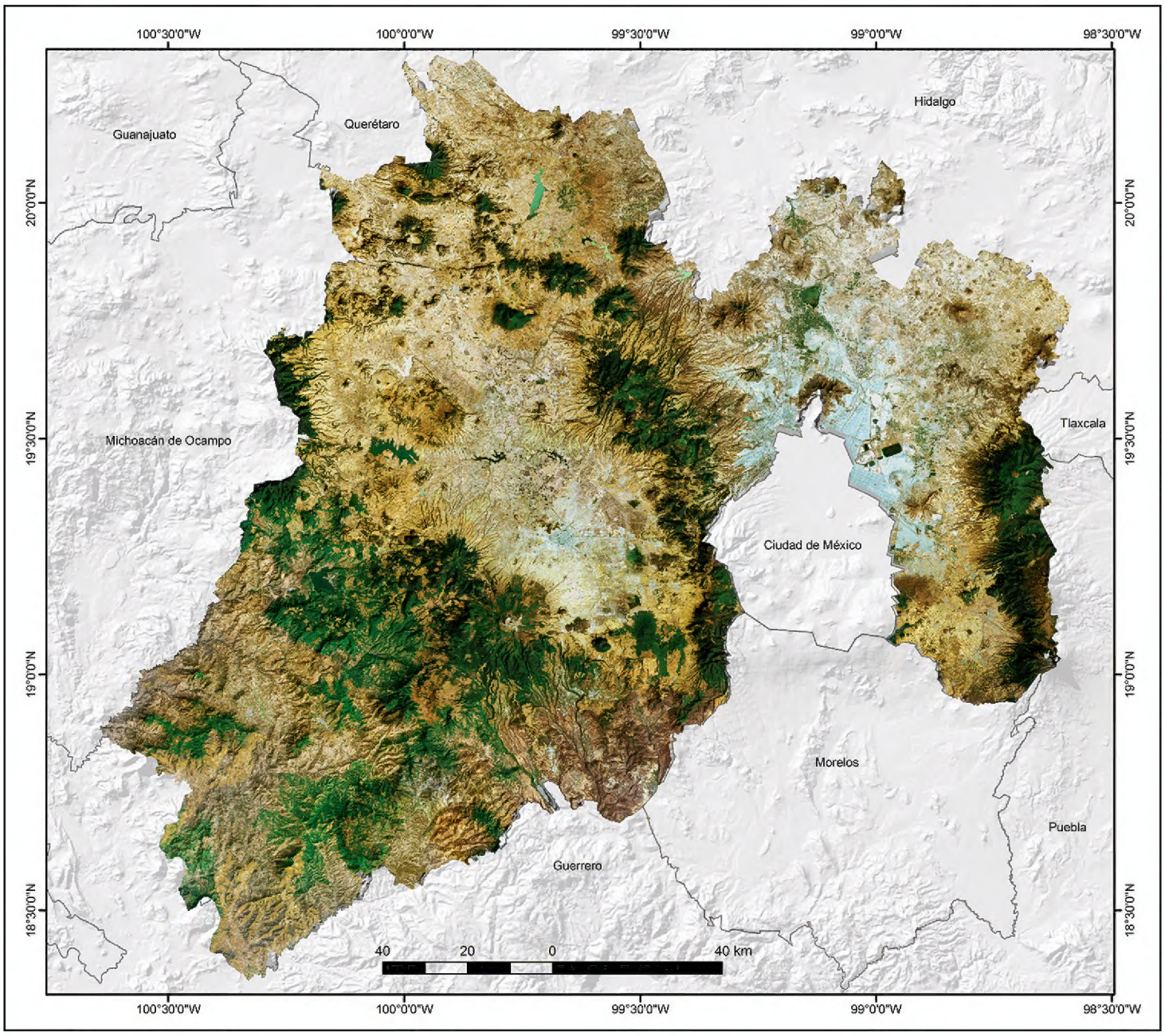

Figure 2. Topographical map of the State of Mexico, Mexico (CONABIO, 1997).

isolated areas in the northern, central, and southwestern parts of the state and they intermingle with Tropical Forests, which are limited to some scattered spots in the Subprovinces of the Sierra Madre del Sur. Tropical Forest, comprising 5.34% of the state's surface area, is represented by Tropical Deciduous Forest, also called Tropical Dry Forest, that develops between 1,500 and 1,600 m altitude. These forests, although lush, lose their leaves during the dry season (winter-spring), and have dense foliage during the rainy season (summer). Scrubland covers only 0.2% of the state's surface area. The remaining 0.41% is represented by scattered areas lacking vegetation (Fig. 4).

Given the geographical location and diversity of the natural regions in the state, there are several climates in the State of Mexico (Fig. 5; modified from López-Cano et al. 2009; INEGI 2017). A warm sub-humid climate with summer rains and semi-humid with summer rains is found in the Balsas Basin in the extreme southwestern part of the state, covering 20.8% of the state area. The temperate sub-humid with summer rains is found over most of the Lerma Basin and Valley of Mexico, covering most of the state (61.7% of the state). The wet semi-cold climate with abundant rains in summer and sub-humid semi-cold with summer rains is present in the highest mountains of

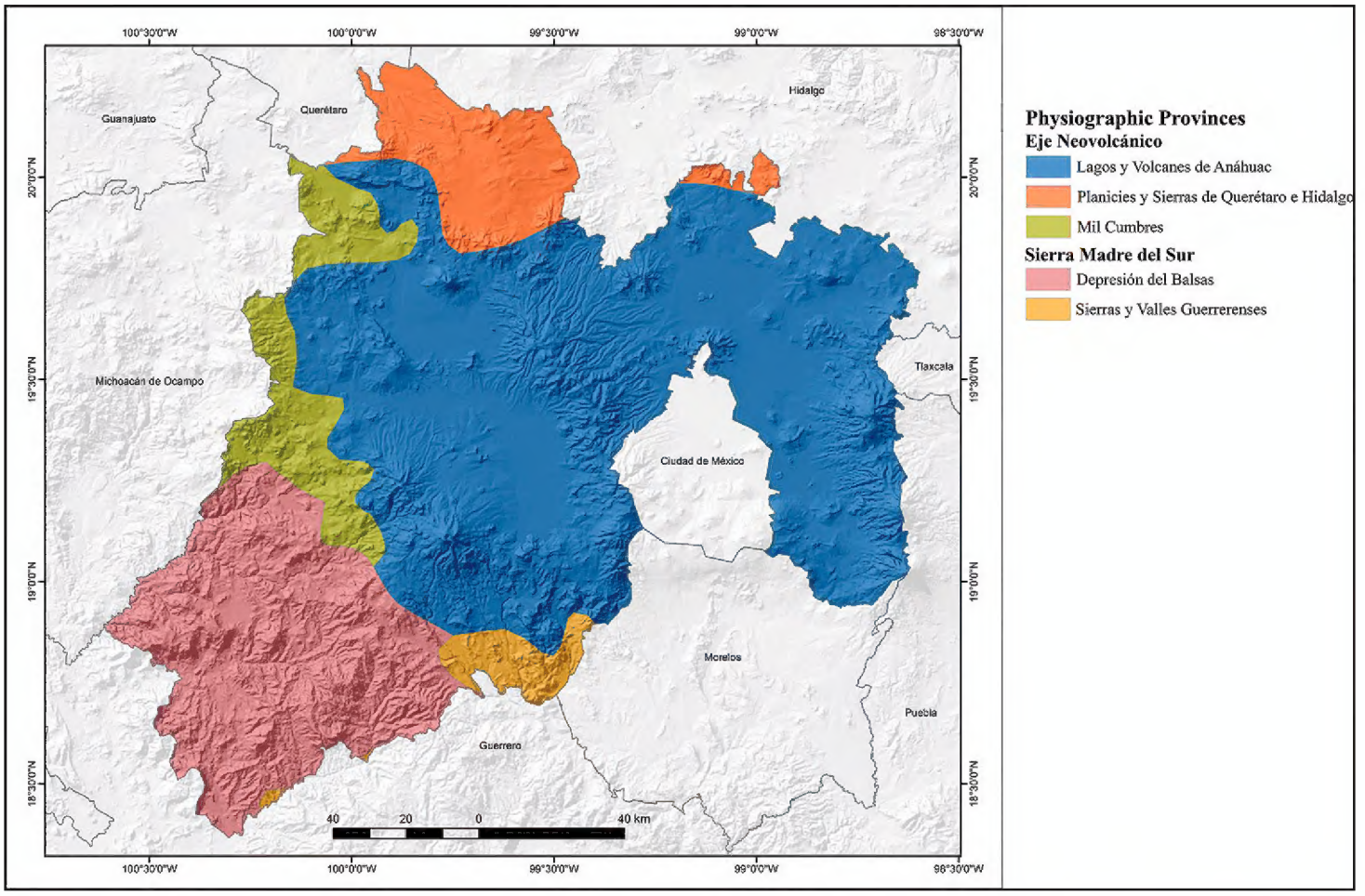

Figure 3. Physiographic provinces of the State of Mexico, Mexico (modified from Cervantes-Zamora et al. 1990).

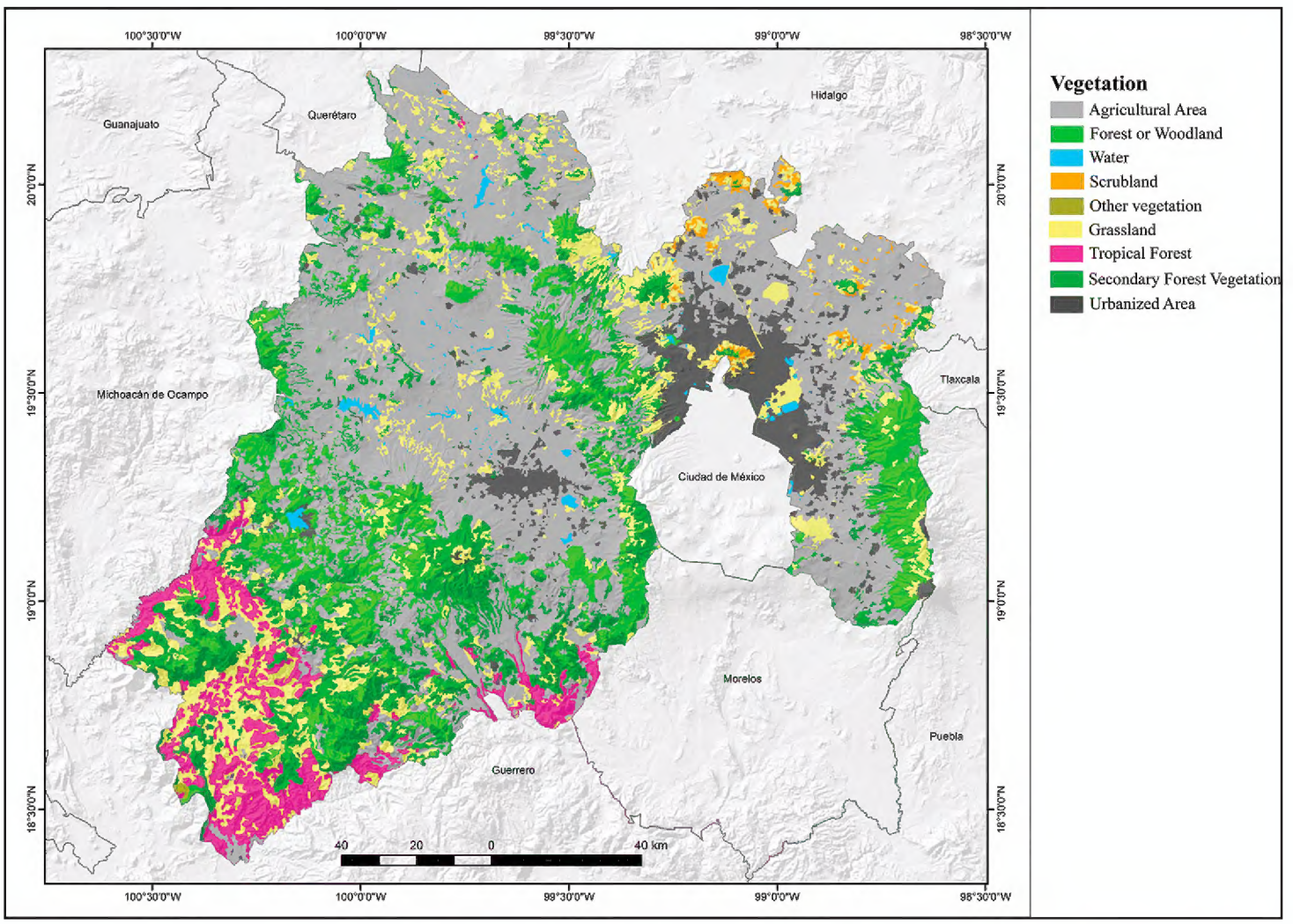

Figure 4. Vegetation map of the State of Mexico, Mexico (modified from Dirección General de Geografía – INEGI 2016).

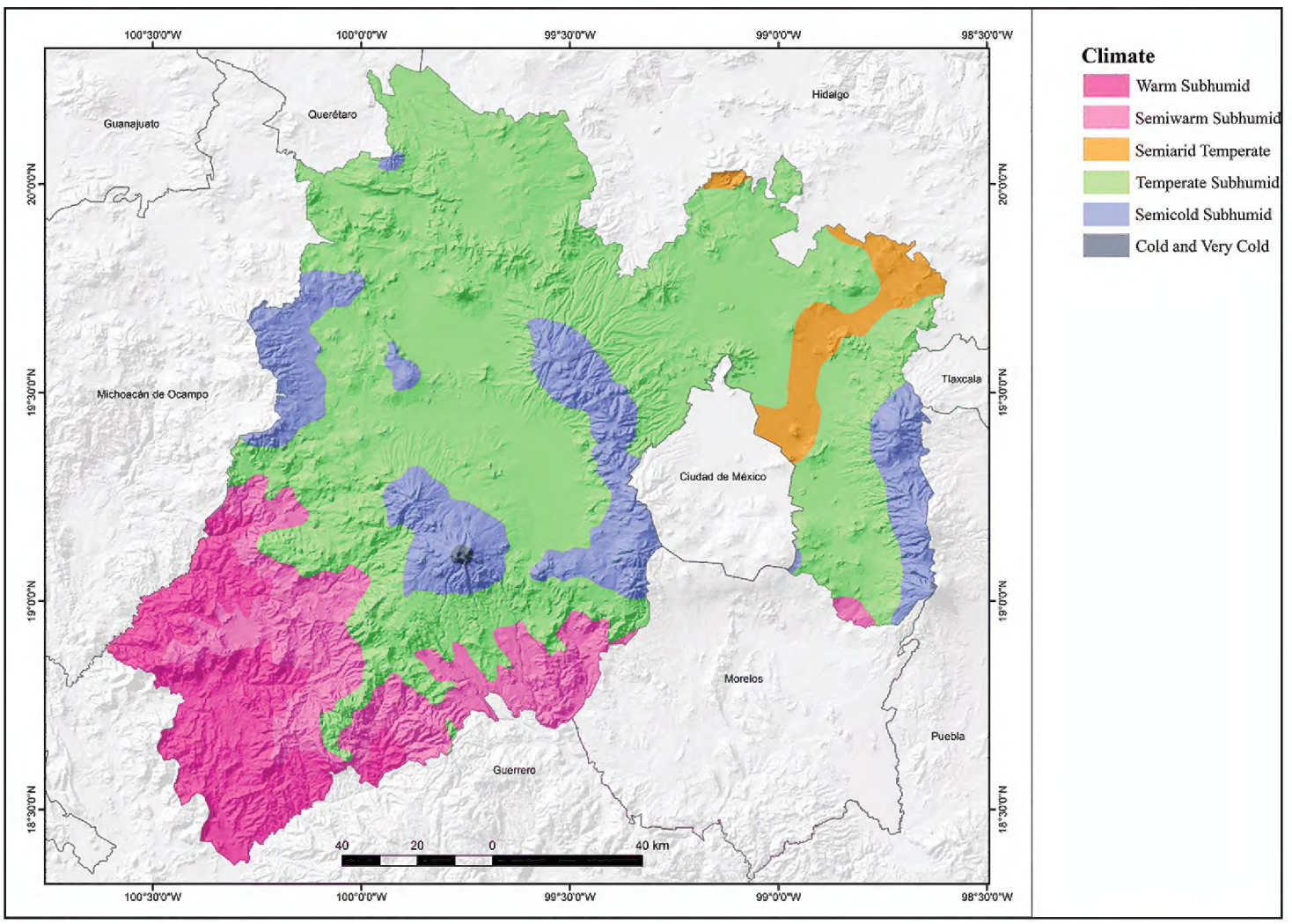

Figure 5. Climate map of the State of Mexico, Mexico (modified from García – Comisión Nacional para el Conocimiento y Uso de la Biodiversidad 1998).

the state (Nevado de Toluca, Sierra Nevada, Sierra las Cruces, Sierra del Ajusco, etc.), covering 11.6% of the state surface. The temperate semi-dry climate is found in the northeast corner of the state, in a strip that runs from the central eastern part of the state, on the northeastern limit of Mexico City to northeastern State of Mexico on the border with Hidalgo, covering 5.7% of the state surface. A Cold climate present on the summits of the Nevado de Toluca, Popocatépetl, and Iztaccíhuatl volcanoes, covering 0.2% of the state's area.

Materials and methods

We compiled our list of amphibians and reptiles of the State of Mexico from our field work over several years, especially within the past 5–10 years, a thorough examination of available literature on amphibians and reptiles in the state, amphibian and reptile records for the State of Mexico in VertNet.org, and amphibian and reptile records for the State of Mexico in Servicio de Descarga de Ejemplares del Sistema Nacional de Información sobre Biodiversidad (SNIB-CONABIO), data bases Amphibians State of Mexico and Reptiles State of Mexico. Amphibian names follow Frost (2019) and AmphibiaWeb (2019) (http://amphibiaweb.org) and reptile names follow Uetz and Hošek

(2019). We included species in the list only if we could confirm records by either direct observation or documented museum records or vouchers.

We made species accumulation curves for the total herpetofauna, and amphibians and reptiles separately using the year of the first recorded observation for each species. These curves can estimate the potential species richness of amphibians and reptiles (see Raxworthy et al. 2012). For each species, we recorded conservation status based on the IUCN Red List 2019-2, listing in SEMARNAT (2019), and Environmental Vulnerability Scores (Wilson et al. 2013a, b; Johnson et al. 2015). We determined the number of species found in the State of Mexico that overlapped with neighboring states and Mexico City using recent state lists (Michoacán, Alvarado-Díaz et al. 2013; Hidalgo, Lemos-Espinal and Smith 2015; Puebla, Woolrich-Piña et al. 2017; Guerrero, Palacios-Aguilar and Flores-Villela 2018; Mexico City, Lemos-Espinal and Smith in press; Morelos, Lemos-Espinal and Smith 2020; and Querétaro, Cruz-Elizalde et al. 2019). We did not include the state of Tlaxcala since no comprehensive check list of the amphibians and reptiles of this state currently exists. We generated border lengths with the INEGI state division map for the year 2018 using ArcMap 10.7.1 neighboring polygon tool (June 2019).

Results and discussion

The State of Mexico is home to 150 species of amphibians and reptiles representing 31 families (two introduced: Gekkonidae and Typhlopidae) and 65 genera (two introduced: *Hemidactylus* and *Indotyphlops*) (Table 1; Fig. 6). The herpetofauna of the State of Mexico includes 49 species of amphibians (33 anurans [one introduced], and 16 salamanders), and 101 reptiles (40 lizards [one introduced], 57 snakes [one introduced], and four turtles). The three introduced species are the American Bullfrog (*Rana catesbeiana*), the Common House Gecko (*Hemidactylus frenatus*), and the Brahminy Blindsnake (*Indotyphlops braminus*). Five of the 147 native species of the State of Mexico are endemic to the state: the Delicate-skinned Salamander (*Ambystoma bombypellum*), the Granular Salamander (*Ambystoma granulosum*), the Lake Lerma Salamander (*Ambystoma lermaense*), Roberts' False Brook Salamander (*Pseudoeurycea robertsi*), and the Herrera Alligator Lizard (*Barisia herrerae*). The most species rich families of amphibians in the State of Mexico are Hylidae, Ambystomatidae, and Plethodontidae, whereas the most species rich families of reptiles are Phrynosomatidae and Colubridae (Table 1).

The species accumulation curves for the total herpetofauna, reptiles, and amphibians all show a steep increase in the number of species documented in the State of Mexico in the second half of the 20th century, and that trend appears to be continuing, albeit at a somewhat slower rate in the 21st century (Fig. 7). This suggests that the overall number of amphibians and reptiles in the State of Mexico is likely to increase over time. Indeed, we compiled a list of 21 species (two amphibians, 19 reptiles: Table 2) that potentially occur in the State of Mexico (Table 2). These potential species are distributed mainly along the border with Guerrero (extreme southwest-

Table 1. Amphibians and reptiles of the State of Mexico with distributional and conservation status. Vegetation Type: (1 = Oak Forest; 2 = Pine-oak Forest; 3 = Pine Forest; 4 = Tropical Deciduous Forest; 5 = Grassland; 6 = Scrubland); IUCN Status: (DD = Data Deficient; LC = Least Concern, VU = Vulnerable, NT = Near Threatened; EN = Endangered; CR = Critically Endangered; NE = not Evaluated) according to the IUCN Red List (IUCN 2019); Environmental Vulnerability Score: (EVS – the higher the score the greater the vulnerability: low (L) vulnerability species (EVS of 3–9); medium (M) vulnerability species (EVS of 10–13); and high (H) vulnerability species (EVS of 14–20) (Wilson et al. 2013a,b; Johnson et al. 2015); conservation status in Mexico according to SEMARNAT (2019): (P = in danger of extinction, A = threatened, Pr = subject to special protection, NL – not listed). Global Distribution: 0 = Endemic to the State of Mexico; 1 = Endemic to Mexico; 2 = Shared between the US and Mexico; 3 = widely distributed from Mexico to Central or South America; 4 = widely distributed from the US to Central or South America; IN = Introduced to State of Mexico. Date in which the first record appeared; and Source of the first record.

	Vegetation type	IUCN status	SEMARNAT	EVS	Global distribution	Year of first record	Source
CLASS AMPHIBIA							
ORDER ANURA							
FAMILY BUFONIDAE (5)							
Anaxyrus compactilis (Wiegmann, 1833)	1,2,5,6	LC	NL	H (14)	1	1888	Dugès 1888
Incilius marmoreus (Wiegmann, 1833)	4	LC	NL	M (13)	1	1930	MCZ-A 17755
Incilius occidentalis (Camerano, 1879)	1,2,3,6	LC	NL	M (11)	1	1941	TCWC 6365
Incilius perplexus (Taylor, 1943)	4	EN	NL	M (11)	1	1983	Camarillo-Rangel 1983
Rhinella horribilis (Wiegmann, 1833)	4	LC	NL	L (3)	4	1941	UIMNH 25155
FAMILY CRAUGASTORIDAE (4)							
Craugastor augusti (Dugès, 1879)	2,6	LC	NL	L (8)	2	1942	Taylor 1942
Craugastor hobartsmithi (Taylor, 1937)	2	EN	NL	H (15)	1	1936	UIMNH 18301
Craugastor pygmaeus (Taylor, 1937)	1,2,3	VU	NL	L (9)	3	1992	Camarillo-Rangel and Smith 1992
Craugastor rugulosus (Cope, 1870)	3	LC	NL	M (13)	3	1968	UTEP Herp:7475
FAMILY ELEUTHERODACTYLIDAE (4)							
Eleutherodactylus angustidigitorum (Taylor, 1940)	1,2,3,6	VU	Pr	H (17)	1	1954	TCWC 11158
Eleutherodactylus maurus Hedges, 1989	1,2,3	DD	Pr	H (17)	1	1954	TCWC 11259
Eleutherodactylus nitidus (Peters, 1870)	1,2,3	LC	NL	M(12)	1	1951	AMNH A-55227
Eleutherodactylus pipilans (Taylor, 1940)	4	LC	NL	M (11)	3	1979	MZFC 3764
FAMILY HYLIDAE (9)							
Dryophytes arenicolor (Cope, 1886)	1,2,3,4,5,6	LC	NL	L (7)	2	1921	MCZ A-8367
Dryophytes eximius (Baird, 1854)	1,2,3,6	LC	NL	M (10)	1	1919	AMNH A 13256
Dryophytes plicatus (Brocchi, 1877)	1,2,3,6	LC	A	M (11)	1	1912	MCZ-A 25699
Exerodonta smaragdina (Taylor, 1940)	4	LC	Pr	M (12)	1	1992	Camarillo-Rangel and Smith 1992
Sarcohyla bistincta (Cope, 1877)	1,2,3	LC	Pr	L (9)	1	1938	UIMNH 17903
Sarcohyla pentheter (Adler, 1965)	4	EN	NL	M (13)	1	2009	Aguilar-Miguel et al. 2009
Smilisca baudinii (Duméril & Bibron, 1841)	1,2,4,6	LC	NL	L (3)	4	1982	CNAR 3912
Smilisca fodiens (Boulenger, 1882)	4	LC	NL	L (8)	2	1968	UTEP H 8448
Tlalocohyla smithii (Boulenger, 1902)	4	LC	NL	M (11)	1	1968	UTEP H 7713
FAMILY LEPTODACTYLIDAE (1)							
Leptodactylus melanonotus (Hallowell, 1861)	4	LC	NL	L (6)	3	1965	ENCB 7687
FAMILY MICROHYLIDAE (1)							
Hypopachus variolosus (Cope, 1866)	4	LC	NL	L (4)	4	1941	ENCB 2905
FAMILY PHYLLOMEDUSIDAE (1)							
Agalychnis dacnicolor (Cope, 1864)	4	LC	NL	M (13)	1	1983	Camarillo-Rangel 1983
FAMILY RANIDAE (7)							
Rana catesbeiana Shaw, 1802	**IN**	**IN**	**IN**	**IN**	**IN**	1982	CNAR 17313
Rana forreri Boulenger, 1883	4	LC	Pr	L (3)	3	1940	CNAR 620
Rana montezumae Baird, 1854	1,2,3,5,6	LC	Pr	M (13)	1	1888	Dugès 1888
Rana neovolcanica Hillis & Frost, 1985	1,2,3	NT	A	M (13)	1	2009	MZFC 23392
Rana spectabilis Hillis & Frost, 1985	1,2,3,5,6	LC	NL	M (12)	1	1936	FMNH 110654
Rana tlaloci Hillis & Frost, 1985	1,2,5,6	CR	P	H (15)	1	1979	ENCB 10567

	Vegetation type	IUCN status	SEMARNAT	EVS	Global distribution	Year of first record	Source
Rana zweifeli Hillis, Frost & Webb, 1984	1,2,3,4,5	LC	NL	M (11)	1	1982	ENCB 11912
FAMILY SCAPHIOPODIDAE (1)							
Spea multiplicata (Cope, 1863)	1,5	LC	NL	L (3)	2	1940	UIMNH 27893
ORDER CAUDATA							
FAMILY AMBYSTOMATIDAE (8)							
Ambystoma altamirani Dugès, 1895	1,2,3,5	EN	A	M (13)	1	1895	Dugès 1895
Ambystoma bombypellum Taylor, 1940	2,5	CR	Pr	H (15)	0	1940	Taylor 1940a
Ambystoma granulosum Taylor, 1944	1,2,3,5	CR	Pr	H (14)	0	1944	Taylor 1944
Ambystoma leorae (Taylor, 1943)	2,3,5	CR	A	H (15)	1	1943	Taylor 1943
Ambystoma lermaense (Taylor, 1940)	5	EN	Pr	H (15)	0	1940	Taylor 1940a
Ambystoma ordinarium Taylor, 1940	?	EN	Pr	M (13)	1	22004	Matias-Ferrer and Murillo 2004a
Ambystoma rivulare (Taylor, 1940)	1,2,3,5	DD	A	M (13)	1	1940	Taylor 1940b
Ambystoma velasci Duges, 1888	1,2,3,5,6	LC	Pr	M (10)	1	1888	Dugès 1888
FAMILY PLETHODONTIDAE (8)							
Aquiloeurycea cephalica (Cope, 1865)	1,2,3,5	NT	A	H (14)	1	1938	UIMNH 30898
Chiropterotriton orculus (cope, 1865)	1,2,3,5	VU	NL	H (18)	1	1951	MVZ 54646
Isthmura belli (Gray, 1850)	1,2,3,5	VU	A	M (12)	1	1938	UIMNH 30881
Pseudoeurycea altamontana (Taylor, 1939)	1,2,3,5	EN	Pr	H (17)	1	1956	UCM 8117
Pseudoeurycea leprosa (Cope, 1869)	1,2,3,5	LC	A	H (16)	1	1921	UMMZ 56989
Pseudoeurycea longicauda Lynch, Wake, & Yang, 1983	1,2,3,5	EN	Pr	H (17)	1	1983	Lynch et al. 1983
Pseudoeurycea robertsi (Taylor, 1939)	1,2,3,5	CR	A	H (18)	1	1939	Taylor 1939
Pseudoeurycea tlilicxitl Lara-Góngora, 2003	1,2,3,5	EN	NL	H (17)	1	2003	Lara-Góngora 2003
CLASS REPTILIA							
SUBORDER LACERTILIA							
FAMILY ANGUIDAE (5)							
Abronia deppii (Wiegmann, 1828)	2	EN	A	H (16)	1	1979	MZFC 6294
Barisia herrerae Zaldivar-Riverón & Nieto Montes de Oca, 2002	2,3	EN	NL	H (15)	0	2002	Zaldivar-Riverón and Nieto Montes de Oca 2002
Barisia imbricata (Wiegmann, 1828)	1,2,3,5,6	LC	Pr	H (14)	1	1888	Dugès 1888
Barisia rudicollis (Wiegmann, 1828)	1,2,3,5	EN	P	H (15)	1	1828	Wiegmann 1828
Gerrhonotus liocephalus Wiegmann, 1828	1,2,3,5	LC	Pr	L (6)	1	1938	FMNH 112024
FAMILY DACTYLOIDAE (1)							
Anolis nebulosus (Wiegmann, 1834)	1,2,4	LC	NL	M (13)	1	1940	UCM 46440
FAMILY GECKONIDAE (1)							
Hemidactylus frenatus Duméril & Bribon, 1836	**IN**	**IN**	**IN**	**IN**	**IN**	1998	Casas-Andreu et al. 1998
FAMILY HELODERMATIDAE (1)							
Heloderma horridum (Wiegmann, 1829)	4	LC	A	M (11)	3	1933	MVZ Herp 16434
FAMILY IGUANIDAE (1)							
Ctenosaura pectinata (Wiegmann, 1834)	4	NE	A	H (15)	1	1982	CNAR 3910
FAMILIY PHRYNOSOMATIDAE (19)							
Phrynosoma orbiculare (Linnaeus, 1758)	1,2,5,6	LC	A	M (12)	1	1888	Dugès 1888
Sceloporus aeneus Wiegmann, 1828	5,6	LC	NL	M (13)	1	1921	MCZ R-16069
Sceloporus anahuacus Lara-Góngora, 1983	1,2,3	LC	NL	H (15)	1	1979	UCM 52300
Sceloporus bicanthalis Smith, 1937	5	LC	NL	M (13)	1	1937	MCZ R-170033
Sceloporus dugesii Bocourt, 1874	2,5	LC	NL	M (13)	1	1983	CNAR 5006
Sceloporus gadoviae Boulenger, 1905	4	LC	NL	M (11)	1	1996	CNAR 12304
Sceloporus grammicus Wiegmann, 1828	1,2,3,6	LC	Pr	L (9)	1	1888	Dugès 1888
Sceloporus horridus Wiegmann, 1834	4	LC	NL	M (11)	1	1951	AMNH R-71351
Sceloporus megalepidurus Smith, 1934	4	VU	Pr	H (14)	1	1971	MCZ R-133166
Sceloporus melanorhinus Bocourt, 1876	4	LC	NL	L (9)	3	1977	MZFC 6312
Sceloporus mucronatus Cope, 1885	2,3,5	LC	NL	M (13)	1	1939	USNM 112207
Sceloporus ochoterenae Smith, 1934	4	LC	NL	M (12)	1	1992	Camarillo-Rangel and Smith 1992
Sceloporus palaciosi Lara-Góngora, 1983	1,2,3	LC	NL	H (15)	1	1976	USNM 245337
Sceloporus pyrocephalus Cope, 1864	4	LC	NL	M (12)	1	1982	CNAR 3900
Scelopours scalaris Wiegmann, 1828	5,6	LC	NL	M (12)	1	1888	Dugès 1888

	Vegetation type	IUCN status	SEMARNAT	EVS	Global distribution	Year of first record	Source
Sceloporus spinosus Wiegmann, 1828	1,2,5,6	LC	NL	M (12)	1	1922	MVZ 8851
Sceloporus sugillatus Smith, 1942	1,2,3	LC	NL	H (16)	1	1939	UIMNH 10753
Sceloporus torquatus Wiegmann, 1828	1,2,3,5,6	LC	NL	M (11)	1	1888	Dugès 1888
Urosaurus bicarinatus (Duméril, 1856)	4	LC	NL	M (12)	1	1930	MCZ R-33686
FAMILY PHYLLODACTYLIDAE (1)							
Phyllodactylus lanei Smith, 1935	4	LC	NL	H (15)	1	1981	CNAR 3550
FAMILY SCINCIDAE (6)							
Marisora brachypoda (Taylor, 1956)	4	LC	NL	L (6)	3	1882	USNM 12718
Plestiodon brevirostris (Günther, 1860)	1,2,3	LC	NL	M (11)	1	1942	KUNHM 25937
Plestiodon copei (Taylor, 1933)	1,2,3	LC	Pr	H (14)	1	1932	USNM 92547
Plestiodon dugesii (Thominot, 1883)	1,2,3	VU	Pr	H (16)	1	1954	KUNHM 38080
Plestiodon indubitus (Taylor, 1933)	1,2,3	NE	NL	H (15)	1	1932	UIMNH 22701
Plestiodon lynxe (Wiegmann, 1834)	1,2,3	LC	Pr	M (10)	1	1974	UTA 4182
FAMILY TEIIDAE (5)							
Aspidoscelis communis (Cope, 1878)	4	LC	Pr	H (14)	1	2009	Aguilar-Miguel et al. 2009
Aspidoscelis costatus (Cope, 1878)	4	LC	Pr	M (11)	1	1941	ENCB 6757
Aspidoscelis deppii (Wiegmann, 1834)	4	LC	NL	L (8)	3	1977	MZFC 5884
Aspidoscelis gularis (Baird & Girard, 1852)	4	LC	NL	L (9)	4	1930	MCZ Herp R-33685
Aspidoscelis sackii (Wiegmann, 1834)	4	LC	NL	H (14)	1	1966	ENCB 4285
SUBORDER SERPENTES							
FAMILY BOIDAE (1)							
Boa sigma Smith, 1943	4	NE	NL	H (15)	1	1985	Camarillo-Rangel et al. 1985
FAMILY COLUBRIDAE (21)							
Conopsis biserialis (Taylor & Smith, 1942)	1,2,3,6	LC	A	M (13)	1	1932	Taylor and Smith 1942
Conopsis lineata (Kennicott, 1859)	1,2,3,6	LC	NL	M (13)	1	1859	Kennicott 1859
Conopsis nasus (Günther, 1858)	1,2,3 ,6	LC	NL	M (11)	1	1921	MCZ R-16128
Drymarchon melanurus (Duméril, Bibron & Duméril, 1854)	4	LC	NL	L (6)	3	1975	ENCB 9028
Drymobius margaritiferus (Schlegel, 1837)	4	LC	NL	L (6)	3	1939	MCZ R-45575
Lampropeltis polyzona Cope, 1860	1,2,3,4,5	LC	NL	L (7)	1	1943	ENCB 2205
Leptophis diplotropis (Günther, 1872)	4	LC	A	H (14)	1	1978	CNAR 3264
Masticophis mentovarius (Duméril, Bibron & Duméril, 1854)	4	LC	A	L (6)	3	1960	KUNHM 67691
Oxybelis aeneus (Wagler, 1824)	4	LC	NL	L (5)	4	1985	Camarillo-Rangel et al. 1985
Pituophis deppei (Dumeril, 1853)	1,2,3,4,6	LC	A	H (14)	1	1853	Dumeril 1853
Pituophis lineaticollis (Cope, 1861)	1,2,3,4,5	LC	NL	L (8)	3	1940	UIMNH 36223 reported by Duellman 1960
Pseudoficimia frontalis (Cope, 1864)	4	LC	NL	M (13)	1	1951	AMNH R-71359
Salvadora bairdi Jan & Sordelli, 1860	1,2,3,4,5,6	LC	Pr	H (15)	1	1888	Dugès 1888
Salvadora mexicana (Duméril, Bibron & Duméril, 1854)	4	LC	Pr	H (15)	1	1982	CNAR 3908
Senticolis triaspis (Cope, 1866)	1,2,4,5	LC	NL	L (6)	3	1943	ENCB 2207
Tantilla bocourti (Günther, 1895)	1,2,5	LC	NL	L (9)	1	1960	KUNHM 67723
Tantilla calamarina Cope, 1866	4	LC	Pr	M (12)	1	1981	UTEP H-13999
Tantilla deppei (Bocourt, 1883)	4	LC	A	M (13)	1	1977	CNAR 1751
Tantilla rubra Cope, 1875	1,2,3,5	LC	Pr	L (5)	3	2009	Aguilar-Miguel et al. 2009
Trimorphodon biscutatus (Duméril, Bibron & Duméril, 1854)	4	NE	NL	L (7)	3	1983	Camarillo-Rangel 1983
Trimorphodon tau Cope, 1870	4	LC	NL	M (13)	1	1943	ENCB 2206
FAMILY DIPSADIDAE (12)							
Conophis vittatus Peters, 1860	4	LC	NL	M (11)	3	2004	Matias-Ferrer and Murillo 2004c
Diadophis punctatus (Linnaeus, 1766)	1,2,3,6	LC	NL	L (4)	2	1937	MZFC 2307
Enulius flavitorques (Cope, 1868)	4	LC	NL	L (5)	3	1951	AMNH R-71357
Geophis bicolor Günther, 1868	4	DD	Pr	H (15)	1	1992	Camarillo-Rangel and Smith 1992
Geophis sieboldi (Jan, 1862)	4	DD	Pr	M (13)	1	1991	MZFC 36
Imantodes gemmistratus (Cope, 1861)	4	LC	Pr	L (6)	3	1951	AMNH R-71361
Leptodeira maculata (Hallowell, 1861)	4,6	LC	Pr	L (7)	1	1965	CNAR 1102

	Vegetation type	IUCN status	SEMARNAT	EVS	Global distribution	Year of first record	Source
Leptodeira septentrionalis (Kennicott, 1859)	4	LC	NL	L (8)	4	1992	Camarillo-Rangel and Smith 1992
Leptodeira splendida Günther, 1895	4	LC	NL	H (14)	1	1976	CNAR 3770
Rhadinaea hesperia Bailey, 1940	4	LC	Pr	M (10)	1	1973	ENCB 7829
Rhadinaea laureata (Günther, 1868)	1,2,3	LC	NL	M (12)	1	1952	KUNHM 39966
Rhadinaea taeniata (Peters, 1863)	1,2	LC	NL	M (13)	1	1979	CNAR 3543
FAMILY ELAPIDAE (3)							
Micrurus browni Schmidt & Smith, 1943	1,2	LC	Pr	L (8)	3	1954	KUNHM 50701
Micrurus laticollaris Peters, 1870	4	LC	Pr	H (14)	1	1986	ENCB 12924
Micrurus tener Baird & Girard, 1953	1,4	LC	NL	M (11)	2	1943	ENCB 2204
FAMILY LEPTOTYPHLOPIDAE (2)							
Epictia bakewelli (Oliver, 1937)	4	NE	NL	NE	1	1985	Camarillo-Rangel et al. 1985
Rena maxima (Loveridge, 1932)	4	LC	NL	M (11)	1	1960	KUNHM 67639
FAMILY NATRICIDAE (7)							
Storeria storerioides (Cope, 1866)	1,2,3	LC	NL	M (11)	1	1938	UIMNH 18771
Thamnophis cyrtopsis (Kennicott, 1860)	1,2,3,4,6	LC	A	L (7)	4	1892	USNM 19003
Thamnophis eques (Reuss, 1834)	1,2,3,4,6	LC	A	L (8)	2	1904	USNM 46599
Thamnophis melanogaster (Wiegmann, 1830)	1,2,3,6	EN	A	H (15)	1	1888	Dugès 1888
Thamnophis pulchrilatus (Cope, 1885)	1,2,3,4	LC	NL	H (15)	1	1888	Dugès 1888
Thamnophis scalaris Cope, 1861	1,2,3,5	LC	A	H (14)	1	1888	Dugès 1888
Thamnohis scaliger (Jan, 1863)	1,2,3,5,6	VU	A	H (15)	1	1939	UMMZ 85367
FAMILY TYPHLOPIDAE (1)							
Indotyphlops braminus (Daudin, 1803)	**IN**	**IN**	**IN**	**IN**	**IN**	1997	CNAR 11307
FAMILY VIPERIDAE (10)							
Crotalus aquilus Klauber, 1952	1,2,3,4,6	LC	Pr	H (16)	1	1982	CNAR 4246
Crotalus atrox Baird & Girard, 1853	5	LC	Pr	L (9)	2	2004	Matias-Ferrer and Murillo 2004b
Crotalus culminatus Klauber, 1952	4	NE	NL	H (15)	1	1888	Dugès 1888
Crotalus molossus Baird & Girard, 1853	1,2,3,6	LC	Pr	L (8)	2	1888	Dugès 1888
Crotalus polystictus (Cope, 1865)	1,2,3,4	LC	Pr	H (16)	1	1888	Dugès 1888
Crotalus ravus Cope, 1865	1,2,3,4,6	LC	A	H (14)	1	1938	UIMNH 19186
Crotalus scutulatus (Kennicott, 1861)	5	LC	Pr	M (11)	2	1967	ENCB 3853
Crotalus tlaloci Bryson, Linkem, Dorcas, Lathrop, Jones, Alvarado-Días, Grünwald & Murphy, 2014	1,2,3,4	NE	NL	H (16)	1	2014	Bryson et al. 2014
Crotalus transversus Taylor, 1944	2,3	LC	P	H (17)	1	1973	KUNHM 159362
Crotalus triseriatus (Wagler, 1830)	1,2,3,4,6	LC	NL	H (16)	1	1940	MVZ 36745
ORDER TESTUDINES							
EMYDIDAE (1)							
Trachemys venusta (Gray, 1855)	4	NE	NL	M (13)	3	1939	MCZ R-45542
FAMILY GEOEMYDIDAE (1)							
Rhinoclemmys rubida (Cope, 1870)	4	NT	Pr	H (14)	1	1983	Camarillo-Rangel 1983
FAMILY KINOSTERNIDAE (2)							
Kinosternon hirtipes (Wagler, 1830)	1,4,5,6	LC	Pr	M (10)	2	1888	Dugès 1888
Kinosternon integrum LeConte, 1854	4	LC	Pr	M (11)	1	1888	Dugès 1888

ern State of Mexico), Hidalgo and Querétaro (northern State of Mexico), Morelos (southern State of Mexico), and Puebla (eastern State of Mexico), and are based on distributional records appearing in Vertnet.org, the Sistema Nacional de Información sobre Biodiversidad (SNIB-CONABIO) for all six neighboring states and Mexico City, Dixon and Lemos-Espinal (2010) for Querétaro; and Lemos-Espinal and Dixon (2016) for Hidalgo. We are convinced that as more herpetological work is done in the areas near the borders between the State of Mexico and its neighboring states, these potential species will likely be documented in the State of Mexico.

Figure 6. A *Ambystoma lermaense* **B** *Chiropterotriton orculus* **C** *Abronia deppii* **D** juvenile *Sceloporus sugillatus* **E** *Crotalus transversus*. Photos by Eric Centenero-Alcalá

General distribution

Thirty-six of the 49 species of amphibians found in the State of Mexico are endemic to Mexico, four of them to the State of Mexico (*Ambystoma bombypellum*, *A. granulosum*, *A. lermaense*, and *Pseudoeurycea robertsi*); twelve are species found mainly along the Eje Neovolcánico of central Mexico; seven are species typical of the Pacific Coast, including the Balsas Depression; three are species characteristics of the Mexican Plateau; seven more are species with a widely distributional patterns in the Mexican Plateau, the Sierra Madre Occidental, Sierra Madre Oriental, Sierra Madre del Sur, and Eje Neovolcánico; and the remaining three are represented by scattered populations in the Mexican Plateau, Sierras Madres, and Eje Neovolcánico (Table 1). Of the 13 amphibian species not endemic to Mexico, four are found in the United States and Mexico,

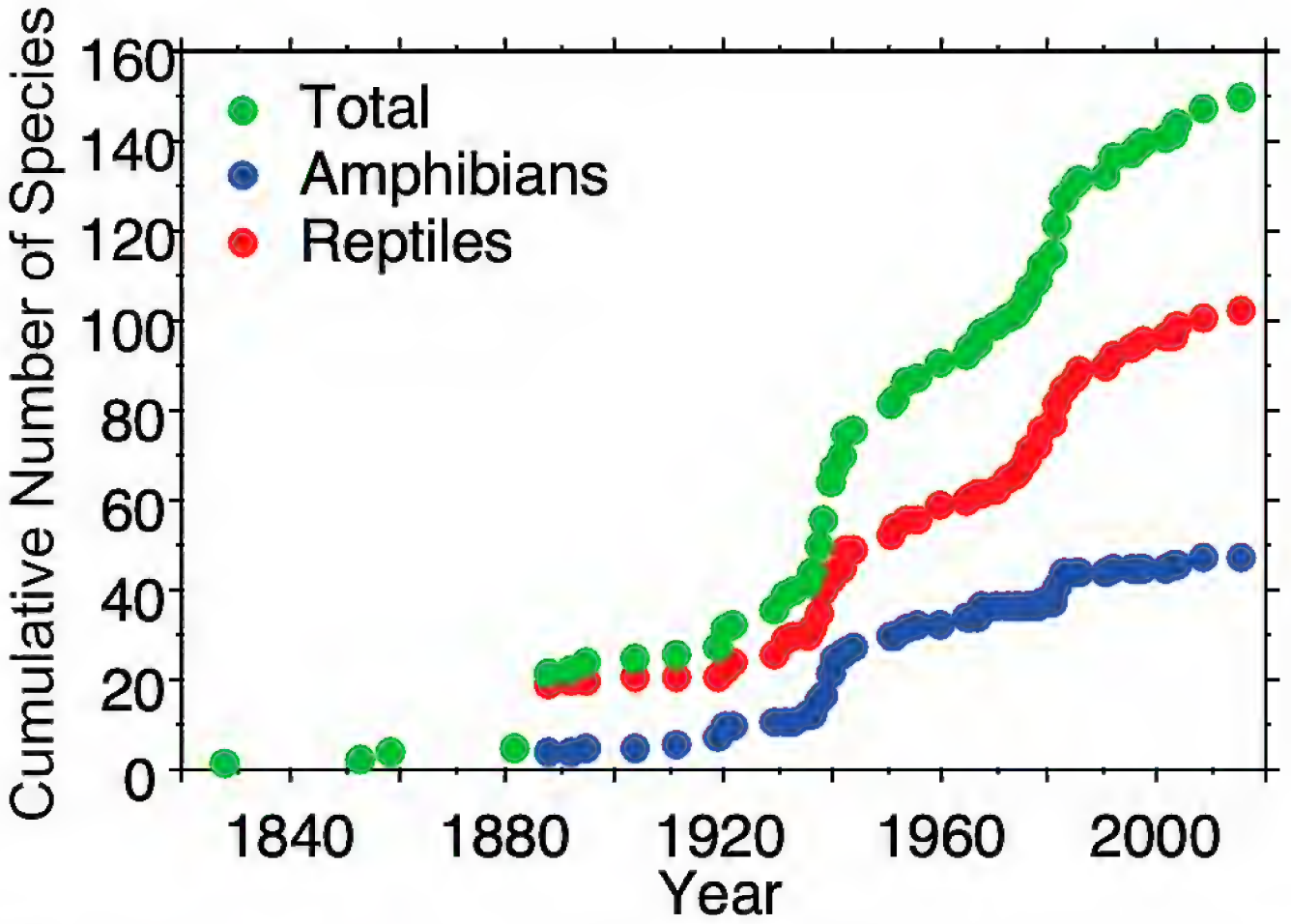

Figure 7. Species accumulation curves for total herpetofauna, amphibians, and reptiles of the State of Mexico, Mexico.

five range from Mexico to Central or even South America, three more are found from southern United States to Central or South America, and one is introduced (Table 1). Thirty-three of the 40 species of lizards that occur in the state are endemic to Mexico; one is endemic to the State of Mexico (*Barisia herrerae*); six are restricted to localities in central Mexico in the State of Mexico, Morelos, Puebla, and Mexico City; ten are typical of the Mexican Pacific Coast; two are limited to the Eje Neovolcánico of central Mexico; six are limited to the central-south part of Mexico, in the Eje Neovolcánico and Sierra Madre del Sur; two are typical of the Mexican Plateau, occurring also in the Eje Neovolcánico or the Sierra Madre del Sur; and six occur in both the Sierra Madre Occidental and Sierra Madre Oriental, and in the Eje Neovolcánico. Of the seven species of lizards found in the State of Mexico but that are not endemic to Mexico, one is found in the United States and Mexico, four are distributed from Mexico to Central America, one is distributed from the United States to Central America, and one is introduced (Table 1). Thirty-six of the 57 species of snakes that inhabit the State of Mexico are endemic to Mexico. Of the 21 snake species not endemic to Mexico that are found in the State of Mexico, six are found in the United States and Mexico, ten range from Mexico to Central or even South America, four are found from central or southern United States to Central or South America, and one is introduced (Table 1). Two of the four species of turtles found in the State of Mexico are endemic to Mexico, one is a species found in the United States and Mexico, and one is distributed from Mexico to Central America (Table 1).

Table 2. List of amphibian and reptile species that potentially occur in the State of Mexico.

	Region in the State of Mexico where it likely occurs
CLASS AMPHIBIA	
ORDER ANURA	
Family Craugastoridae	
Craugastor rhodopis (Cope, 1867)	southern
Family Hylidae	
Scinax staufferi (Cope, 1865)	southern
CLASS REPTILIA	
ORDER SQUAMATA	
SUBORDER AMPHISBAENIA	
Family Bipedidae	
Bipes canaliculatus Latreille, 1801	extreme southwestern
SUBORDER LACERTILIA	
Family Anguidae	
Gerrhonotus ophiourus Cope, 1867	eastern and southern
Family Eublepharidae	
Coleonyx elegans Gray, 1845	extreme southwestern
Family Phrynosomatidae	
Phrynosoma asio Cope, 1864	extreme southwestern
Sceloporus minor Cope, 1885	northern
Sceloporus siniferus Cope, 1870	extreme southwestern
Sceloporus utiformis Cope, 1864	extreme southwestern
Family Phyllodactylidae	
Phyllodactylus bordai Taylor, 1942	extreme southwestern
Phyllodactylus tuberculosus Wiegmann, 1834	extreme southwestern
Family Teiidae	
Holcosus sinister (Wiegmann, 1834)	extreme southwestern
SUBORDER SERPENTES	
Family Colubridae	
Ficimia publia (Cope, 1866)	extreme southwestern
Lampropeltis ruthveni Blanchard, 1920	northern
Mastigodryas melanolomus (Cope, 1868)	extreme southwestern
Sonora michoacanensi (Dugès, 1884)	western and southwestern
Family Dipsadidae	
Pseudoleptodeira latifasciata (Günther, 1894)	extreme southwestern
Tropidodipsas zweifeli (Liner & Wilson, 1970)	extreme southwestern
Family Loxocemidae	
Loxocemus bicolor Cope, 1861	extreme southwestern
Family Viperidae	
Agkistrodon bilineatus Günther, 1863	extreme southwestern
ORDER TESTUDINES	
Family Kinosternidae	
Kinosternon scorpioides (Linnaeus, 1766)	western and southwestern

Habitat types

In the State of Mexico, the percentage of herpetofaunal species found in the Oak (51.7%), Pine-oak (55.8%), Pine (44.9%), and Tropical Deciduous Forest (51.7%) vegetation types are relatively equal (Table 1). However, the Grassland (29.9%) and Scrubland (23.8%) vegetation types have relatively fewer species. This pattern of the observed percentage of species in each habitat type is the same for amphibians and reptiles individually in the Oak, Pine-oak, and Pine Forests; and in the Scrubland. However, the Tropical Deciduous Forest contains a higher percentage of reptiles (80.3%)

than for amphibians (19.7%), which might be due to the dry conditions of this vegetation type. The percentage of species found in the Grassland is the same for amphibians as for reptiles (50.0% for both), perhaps due to the high altitude grasslands that intermingle with Pine Forest in the State of Mexico, and these grasslands often traverse streams which host important populations of hylids, ranids, ambystomatids, anguids, phrynosomatids, colubrids, and vipers in the State of Mexico.

Conservation status

Of the amphibian and reptile species in the State of Mexico, 20.1% are IUCN listed (i.e., Vulnerable, Near Threatened, or Endangered), 18.4% are placed in a protected category by SEMARNAT (excluding NL and Pr, this last category is equivalent to the LC category of IUCN), and 34.9% are categorized as high risk by the EVS (Table 3; Fig. 8). For amphibians, 41.7% are IUCN listed, 20.8% are protected by SEMARNAT, and 33.3% are at high risk according to the EVS (Table 3; Fig. 8). For reptiles, 8.8% are listed by the IUCN, 17.2% are protected by SEMARNAT, and 35.7% are at high risk according to the EVS (Table 3; Fig. 8). These results suggest that many amphibians found in the State of Mexico are at risk and of relatively high conservation concern at both the global and national scale. However, the reptiles found in the State of Mexico are less at risk according to the global and national assessments of the IUCN and SEMARNAT, respectively; but the EVS suggests they may be at higher risk than the IUCN and SEMARNAT assessments suggest. Based on our review of the conservation statuses of the herpetofauna found in the State of Mexico, we have identified several families that include species of particular conservation concern. These families include Craugastoridae, Eleutherodactylidae, Ambystomatidae, Plethodontidae, Helodermatidae, Iguanidae, Phrynosomatidae, Colubridae, Natricidae, and Viperidae (Table 3). Because the conservation statuses we reviewed are developed and applied at a species wide level, we believe that the conservation status of specific taxa in the State of Mexico may not be accurately reflected by these measures. Additional state level assessments are needed, especially for species in the families we have identified as being at a particularly high level of risk.

We summarized the conservation status of amphibian and reptile taxa in each vegetation type found in the State of Mexico to determine the vegetation types that support species of particular conservation concern (Table 1). For IUCN listings, 43.3% of amphibian species in the Oak Forest are listed in a protected category; 48.5% in the Pine-oak Forest; 50.0% in the Pine Forest; 13.3% in the Tropical Deciduous Forest; 59.1% in the Grassland; and 16.7% in the Scrubland. For SEMARNAT listings of amphibian species, 30.0% in the Oak Forest are listed in a protected category; 30.3% in the Pine-oak Forest; 34.6% in the Pine Forest; 0% in the Tropical Deciduous Forest; 36.4% in the Grassland; and 16.7% in the Scrubland. For EVS, 40.0% of amphibian species in the Oak Forest of the State of Mexico were in the high category, 45.5% in the Pine-oak Forest, 42.3% in the Pine Forest, 0% in the Tropical Deciduous Forest, 54.5% in the Grassland, and 25.0% in the Scrubland. For IUCN listings, 8.9% of reptile species in

Table 3. Summary of native species present in the State of Mexico by family, order or suborder, and class. Status summary indicates the number of species found in each IUCN conservation status in the order DD, LC, VU, NT, EN, CR (see Table 1 for abbreviations; in some cases species have not been assigned a status by the IUCN and therefore these may not add up to the total number of species in a taxon). Mean EVS is the mean Environmental Vulnerability Score; scores ≥ 14 are considered high vulnerability (Wilson et al. 2013a, b) and conservation status in Mexico according to SEMARNAT (2019) in the order NL, Pr, A, P (see Table 1 for abbreviations).

Scientific name	Genera	Species	IUCN	$\bar{x}$ EVS	SEMARNAT
			DD, LC, VU, NT, EN, CR		NL, Pr, A, P
CLASS AMPHIBIA					
ORDER ANURA	**15**	**32**	**1,24,2,1,3,1**	**10.3**	**20,9,2,1**
Bufonidae	3	5	0,4,0,0,1,0	10.4	5,0,0,0
Craugastoridae	1	4	0,2,1,0,1,0	11.25	4,0,0,0
Eleutherodactylidae	1	4	1,2,1,0,0,0	14.3	2,2,0,0
Hylidae	5	9	0,8,0,0,1,0	9.3	6,2,1,0
Leptodactylidae	1	1	0,1,0,0,0,0	6	0,1,0,0
Microhylidae	1	1	0,1,0,0,0,0	4	0,1,0,0
Phyllomedusidae	1	1	0,1,0,0,0,0	13	0,1,0,0
Ranidae	1	6	0,4,0,1,0,1	11.2	2,2,1,1
Scaphiopodidae	1	1	0,1,0,0,0,0	3	1,0,0,0
ORDER CAUDATA	**5**	**16**	**1,2,2,1,5,5**	**14.8**	**2,7,7,0**
Ambystomatidae	1	8	1,1,0,0,2,4	13.5	0,5,3,0
Plethodontidae	4	8	0,1,2,1,3,1	16.1	2,2,4,0
SUBTOTAL	**20**	**48**	**2,26,4,2,8,6**	**11.8**	**22,16,9,1**
CLASS REPTILIA					
ORDER SQUAMATA	**40**	**95**	**2,79,3,0,4,0**	**11.5**	**53,25,15,2**
SUBORDER LACERTILIA	**13**	**39**	**0,32,2,0,3,0**	**12.4**	**25,9,4,1**
Anguidae	3	5	0,2,0,0,3,0	13.2	1,2,1,1
Dactyloidae	1	1	0,1,0,0,0,0	13	1,0,0,0
Helodermatidae	1	1	0,1,0,0,0,0	11	0,0,1,0
Iguanidae	1	1	0,0,0,0,0,0	15	0,0,1,0
Phrynosomatidae	3	19	0,18,1,0,0,0	12.4	16,2,1,0
Phyllodactylidae	1	1	0,1,0,0,0,0	15	1,0,0,0
Scincidae	2	6	0,4,1,0,0,0	12	3,3,0,0
Teiidae	1	5	0,5,0,0,0,0	11.2	3,2,0,0
SUBORDER SERPENTES	**27**	**56**	**2,47,1,0,1,0**	**11**	**28,16,11,1**
Boidae	1	1	0,0,0,0,0,0	15	1,0,0,0
Colubridae	13	21	0,20,0,0,0,0	10	12,4,5,0
Dipsadidae	7	12	2,10,0,0,0,0	9.8	7,5,0,0
Elapidae	1	3	0,3,0,0,0,0	11	1,2,0,0
Leptotyphlopidae	2	2	0,1,0,0,0,0	11	2,0,0,0
Natricidae	2	7	0,5,1,0,1,0	11.5	2,0,5,0
Viperidae	1	10	0,8,0,0,0,0	13.8	3,5,1,1
ORDER TESTUDINES	**3**	**4**	**0,2,0,1,0,0**	**12**	**1,3,0,0**
Emydidae	1	1	0,0,0,0,0,0	13	1,0,0,0
Geoemydidae	1	1	0,0,0,1,0,0	14	0,1,0,0
Kinosternidae	1	2	0,2,0,0,0,0	10.5	0,2,0,0
SUBTOTAL	**43**	**99**	**2,81,3,1,4,0**	**11.6**	**54,28,15,2**
TOTAL	**63**	**147**	**4107,7,3,12,6**	**11.7**	**76,44,24,3**

the Oak Forest are listed in a protected category; 12.5% in the Pine-oak Forest; 12.5% in the Pine Forest; 3.8% in the Tropical Deciduous Forest; 9.1% in the Grassland; and 8.7% in the Scrubland. For SEMARNAT listings of reptile species, 22.2% in the Oak Forest are listed in a protected category; 25.0% in the Pine-oak Forest; 25.6% in the Pine Forest; 15.0% in the Tropical Deciduous Forest; 18.2% in the Grassland; and 34.8% in the Scrubland. For EVS, 42.2% of reptile species in the Oak Forest of the State of Mexico were in the high category, 45.8% in the Pine-oak Forest, 53.8% in the Pine Forest, 35.0% in the Tropical Deciduous Forest, 22.7% in the Grassland, and

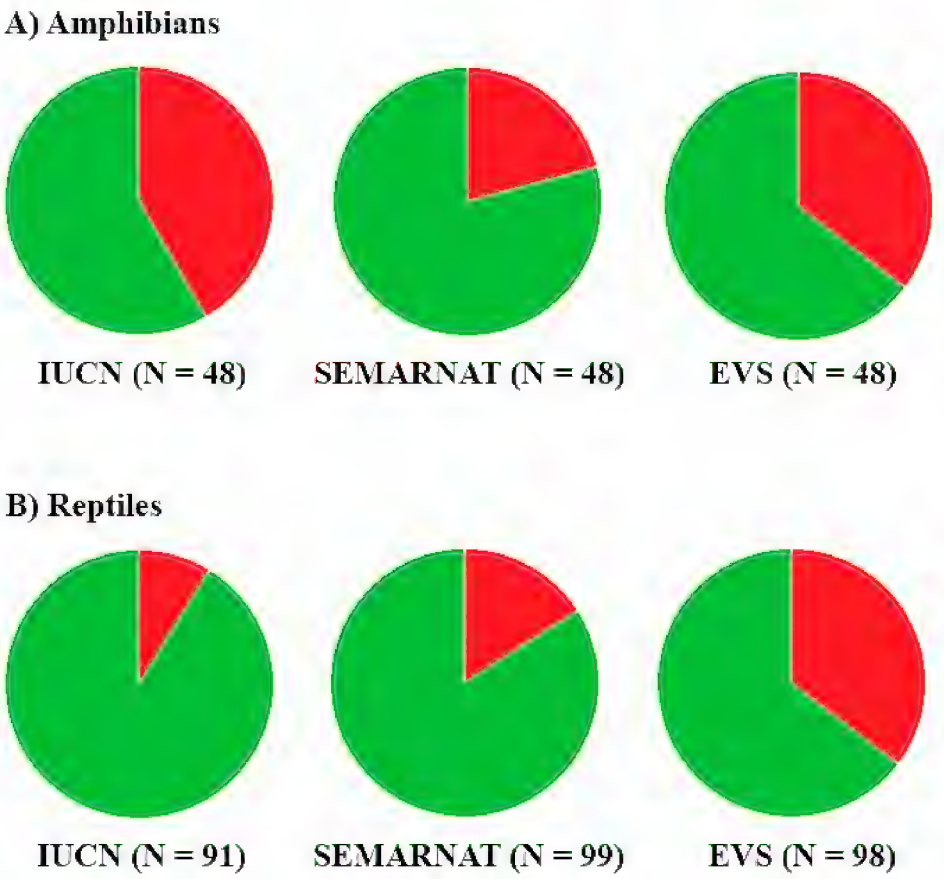

Figure 8. Proportion of **A**) amphibians and **B**) reptiles listed in protected categories on the IUCN Red List, SEMARNAT, and high EVS for the State of Mexico. Green is proportion in Data Deficient and Least Concern (IUCN); Not Listed and Subject to Special Protection (we regarded the category of Subject to Special Protection in SEMARNAT equivalent to Least Concern in IUCN) (SEMARNAT); or low or medium EVS. Red is percentage in protected categories or high EVS. N is the number of species assessed.

34.8% in the Scrubland. Given the apparent importance of forested habitats in terms of protected amphibian and reptile species in the State of Mexico, efforts to maintain or expand such habitats, perhaps by reforestation, is a management strategy that needs to be considered. Indeed, Sánchez-Jasso et al. (2013) found that reforested woodlands in the State of Mexico supported a relatively high richness of vertebrates.

Comparison with neighboring states

Overall, the State of Mexico shares the most species (76.9%) with Michoacán (Table 4). The State of Mexico also shares the most amphibian species with Michoacán (72.9%), including 87.5% of its anuran species, and 43.8% of its salamander species. These two states are especially important for salamanders in the family Ambystomatidae and contribute 11 of the 14 species of the regional pool, only lacking *A. mexicanum* (endemic to Mexico City), *A. taylori* (endemic to Puebla), and *A. subsalsum*. For reptiles, the State of Mexico shares 78.8% of its reptile species with Michoacán. The similarity between these two states is due to the long border between them (241 km, INEGI 2018) and the fact that the larger Michoacán contains essentially all of the vegetation types present in the State of Mexico. In contrast, the state that shares the second highest number of species with the State of Mexico is the small state of Morelos. Morelos, along with the State of Mexico and Mexico City,

Table 4. Summary of the numbers of species shared between the State of Mexico and neighboring Mexican states (not including introduced species). The percent of the State of Mexico species shared by a neighboring state are given in parentheses. – indicates either the State of Mexico or the neighboring state has no species in the taxonomic group, or none of that specific taxon is shared between the states, thus no value for shared species is provided.

Taxon	State of Mexico	Michoacán	Morelos	Puebla	Guerrero	Hidalgo	Querétaro	Mexico City
CLASS AMPHIBIA	**48**	**35 (72.9)**	**33 (68.8)**	**27 (56.3)**	**26 (55.3)**	**20 (41.7)**	**16 (33.3)**	**16 (33.3)**
ORDER ANURA	**32**	**28 (87.5)**	**26 (81.3)**	**23 (71.9)**	**23 (71.9)**	**16 (50.0)**	**13 (40.6)**	**8 (25.0)**
Bufonidae	5	5 (100)	5 (100)	5 (100)	4 (80.0)	3 (60.0)	3 (60.0)	1 (20.0)
Craugastoridae	4	3 (75.0)	4 (100)	3 (75.0)	4 (100)	1 (25.0)	1 (25.0)	1 (25.0)
Eleutherodactylidae	4	3 (75.0)	3 (75.0)	1 (25.0)	2 (50.0)	1 (25.0)	1 (25.0)	–
Hylidae	9	8 (88.9)	7 (77.8)	7 (77.8)	7 (77.8)	5 (55.6)	3 (33.3)	3 (33.3)
Leptodactylidae	1	1 (100)	0	1 (100)	1 (100)	1 (100)	–	–
Microhylidae	1	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	–
Phyllomedusidae	1	1 (100)	1 (100)	1 (100)	1 (100)	–	–	–
Ranidae	6	5 (83.3)	4 (66.7)	3 (50.0)	2 (33.3)	3 (50.0)	3 (50.0)	2 (33.3)
Scaphiopodidae	1	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)
ORDER CAUDATA	**16**	**7 (43.8)**	**7 (43.8)**	**4 (25.0)**	**3 (18.8)**	**4 (25.0)**	**3 (18.8))**	**8 (50.0)**
Ambystomatidae	8	4 (50.0)	1 (12.5)	1 (12.5)	1 (12.5)	1 (12.5)	1 (12.5)	2 (25.0)
Plethodontidae	8	3 (37.5)	6 (75.0)	3 (37.5)	2 (25.0)	3 (37.5)	2 (25.0)	6 (75.0)
CLASS REPTILIA	**99**	**78 (78.8)**	**73 (71.8)**	**71 (71.7)**	**65 (65.7)**	**47 (47.5)**	**45 (45.5)**	**43 (43.4)**
ORDER SQUAMATA	**95**	**75 (78.9)**	**71 (74.7)**	**69 (72.6)**	**63 (66.3)**	**44 (46.3)**	**43 (45.3)**	**41 (43.2)**
SUBORDER LACERTILIA	**39**	**28 (71.8)**	**29 (74.4)**	**26 (66.7)**	**26 (66.7)**	**12 (30.8)**	**10 (25.6)**	**14 (35.9)**
Anguidae	5	3 (60.0)	4 (80.0)	2 (40.0)	3 (60.0)	1 (20.0)	1 (20.0)	1 (20.0)
Dactyloidae	1	1 (100)	1 (100)	–	1 (100)	–	–	–
Helodermatidae	1	1 (100)	1 (100)	1 (100)	1 (100)	–	–	–
Iguanidae	1	1 (100)	1 (100)	1 (100)	1 (100)	–	–	–
Phrynosomatidae	19	12 (63.2)	14 (73.7)	15 (78.9)	12 (63.2)	9 (47.4)	7 (36.8)	10 (52.6)
Phyllodactylidae	1	1 (100)	–	–	1 (100)	–	–	–
Scincidae	6	4 (66.7)	4 (66.7)	4 (66.7)	3 (50.0)	1 (16.7)	1 (16.7)	2 (33.3)
Teiidae	5	5 (100)	4 (80.0)	3 (60.0)	4 (80.0)	1 (20.0)	1 (20.0)	1 (20.0)
SUBORDER SERPENTES	**56**	**47 (83.9)**	**42 (75.0)**	**43 (76.8)**	**37 (66.1)**	**32 (57.1)**	**33 (58.9)**	**27 (48.2)**
Boidae	1	1 (100)	1 (100)	1 (100)	1 (100)	–	–	–
Colubridae	21	19 (90.5)	19 (90.5)	20 (95.2)	18 (85.7)	13 (61.9)	14 (66.7)	9 (42.9)
Dipsadidae	12	11 (91.7)	8 (66.7)	7 (58.3)	8 (66.6)	5 (41.7)	4 (33.3)	4 (33.3)
Elapidae	3	2 (66.7)	2 (66.7)	2 (66.7)	2 (66.6)	1 (33.3)	1 (33.3)	1 (33.3)
Leptotyphlopidae	2	2 (100)	1 (50.0)	1 (50.0)	2 (100)	1 (50.0)	1 (50.0)	–
Natricidae	7	7 (100)	4 (57.1)	6 (85.7)	3 (42.9)	6 (85.7)	6 (85.7)	7 (100)
Viperidae	10	5 (50.0)	7 (70.0)	6 (60.0)	3 (30.0)	6 (60.0)	7 (70.0)	6 (60.0)
ORDER TESTUDINES	**4**	**3 (75.0)**	**2 (50.0)**	**2 (50.0)**	**2 (50.0)**	**3 (75.0)**	**2 (50.0)**	**2 (50.0)**
Emydidae	1	–	–	1 (100)	–	1 (100)	–	–
Geoemydidae	1	1 (100)	–	–	1 (100)	–	–	–
Kinosternidae	2	2 (100)	2 (100)	1 (50.0)	1 (50.0)	2 (100)	2 (100)	2 (100)
TOTAL	**147**	**113 (76.9)**	**106 (72.1)**	**98 (66.7)**	**91 (61.9)**	**67 (45.6)**	**61 (41.5)**	**59 (40.1)**

share parts of the Corredor Biológico Chichinautzin, which includes the Lagunas de Zempoala National Park, that hosts a unique assortment of amphibians and reptiles. Moreover, Morelos shares part of the Tropical Deciduous Forest with the southern part of the State of Mexico. Puebla and Guerrero also share a large number of species with the State of Mexico. Hidalgo, Querétaro, and Mexico City share fewer amphibian and reptile species with the State of Mexico. Hidalgo and Querétaro are states whose dominant species are from the Mexican Altiplano and the Sierra Madre Oriental, whereas the dominant species for the State of Mexico are a combination of

species of the Eje Neovolcánico and the Sierra Madre del Sur. The lower number of shared species among these states may also reflect the inherent species richness of the shared habitat types. In addition, the border of Querétaro with the State of Mexico is quite short (95.3 km, INEGI 2018), and although the border of Hidalgo with the State of Mexico is the longest of the other neighboring states (422.3 km, INEGI 2018), most of this border is confined to the subprovince of Llanuras and Sierras de Querétaro e Hidalgo, with a sole contribution of species typical of the Mexican Altiplano. On the other hand, although Mexico City is nearly surrounded by the State of Mexico, its small size (1,485 km^2) along with its large urbanized area, results in a small number of species of amphibians and reptiles (63: Lemos-Espinal and Smith, in press), which also results in an equally small number of species shared between Mexico City and the State of Mexico (59). However, 93.7% of the total number of species recorded for Mexico City is shared with the State of Mexico.

Acknowledgments

We thank Jesús Sigala and John Murphy for very helpful comments that greatly improved the manuscript. Support for this study was provided by Dirección General de Asuntos del Personal Académico, Programa de Apoyo a Proyectos de Investigación e Innovación Tecnológica (DGAPA-PAPIIT) through the Project IN215418. We are grateful to Alejandra Núñez Merchand from the National Commission for the Understanding and Use of Biodiversity (CONABIO) for kindly creating and providing the municipality, topographic, physiographic, climate, and vegetation maps used in this publication and for generating the state border lengths of the State of Mexico's neighboring states, and to Isabel Cruz, also from CONABIO, for providing the satellite images of the State of Mexico. We are grateful to Alan Resetar and Joshua Mata from the Field Museum of Natural History, Chicago, Illinois; Emily M. Braker from the University of Colorado Museum, University of Colorado at Boulder; Jimmy McGuire, Carol Spencer, and David Wake from the Museum of Vertebrate Zoology at Berkeley, University of California at Berkeley; and D. Dickey and D.A. Kizirian from the American Museum of Natural History, New York. Eric Centenero-Alcalá kindly allowed us to use his photographs in Figure 6.

References

Aguilar Miguel X, Casas Andreu G, Cárdenas Ramos PJ, Cantellano de Rosas E (2009) Análisis espacial y conservación de los anfibios y reptiles del Estado de México. Ciencia Ergo Sum 16: 171–180.

Alvarado-Díaz J, Suazo-Ortuño I, Wilson LD, Medina-Aguilar O (2013) Patterns of physiographic distribution and conservation status of the herpetofauna of Michoacán, México. Amphibian & Reptile Conservation 7(1): 128–170.

AmphibiaWeb (2019) AmphibiaWeb. University of California, Berkeley. https://amphibiaweb.org [accessed 29 November 2019]

Bautista-Olivas AL, Tovar-Salinas JL, Mancilla-Villa OR, Flores-Magdaleno H, Ramírez-Ayala C, Arteaga-Ramírez R, Vázquez-Peña M (2014) Concentración de metales traza en el agua condensada de humedad atmosférica en el Valle de México. Interciencia 39(4): 234–240.

Bryson RW, Linkem CW, Dorcas ME, Lathrop A, Jones JM, Alvarado-Díaz J, Grünwald CI, Murphy RW (2014) Multilocus species delimitation in the *Crotalus triseriatus* species group (Serpentes: Viperidae: Crotalinae), with the description of two new species. Zootaxa 3826(3): 475–496. https://doi.org/10.11646/zootaxa.3826.3.3

Camarillo-Rangel JL (1983) New herpetological records from the state of México. Bulletin of the Maryland Herpetological Society 19(2): 39–46.

Camarillo-Rangel JL, Aguilar-Cortes R, González-Ruiz A (1985) Distributional records of amphibians and reptiles from the state of México. Herpetological Review 16(3): 1–85.

Camarillo-Rangel JL, Smith HM (1992) A handlist of the amphibians and reptiles of the State of Mexico, Mexico. In: Strimple PD, Strimple JL (Eds) Contributions in Herpetology. Greater Cincinnati Herpetological Society, Cincinnati, 111 pp.

Casas-Andreu G, Barrios-Quiroz G, Cruz-Avina R (1998) *Hemidactylus frenatus*. México: México. Herpetological Review 29(1): 1–51.

Cervantes-Zamora Y, Cornejo-Olgín SL, Lucero-Márquez R, Espinoza-Rodríguez JM, Miranda-Viquez E, Pineda-Velázquez A (1990) 'Provincias Fisiográficas de México'. Extraído de Clasificación de Regiones Naturales de México II, IV.10.2. Atlas Nacional de México (Vol. II). Escala 1:4000000. Instituto de Geografía, UNAM. México.

CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad) (1997) "Modelo Digital del Terreno". Escala 1:250 000. México.

CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad) (2018) Sistema Nacional de Información sobre Biodiversidad. Registros de ejemplares. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Registros Curatoriales Anfibios, Reptiles para el estado de México. Ciudad de México, México.

Cruz-Elizalde R, Ramírez-Bautista A, Hernández-Salinas U, Berriozabal-Islas C, Wilson LD (2019) An updated checklist of the herpetofauna of Querétaro, México: species richness, diversity, and conservation status. Zootaxa 4638(2): 273–290. https://doi.org/10.11646/zootaxa.4638.2.7

Dixon JR, Lemos-Espinal JA (2010) Anfibios y Reptiles del Estado de Querétaro, México / Amphibians and Reptiles of the State of Querétaro, México. CONABIO, México, 428 pp.

Duellman WE (1960) A taxonomic study of the Middle American Snake, *Pituophis deppei*. University of Kansas Publications. Museum of Natural History 10(10): 599–610.

Dugès AAD (1888) Erpetología del Valle de México. La Naturaleza. Serie 2. México 1: 97–146.

Dugès AAD (1895) Description d'un Axolotl des Montagnes de las Cruces (*Amblystoma altamirani*, A. Dugès). Institut Médico-Nacional, Imprimèrie du Ministère de Fomento, México, 64 pp.

Duméril AMC (1853) Prodrome de la classification des reptiles ophidiens. Mémoires de l'Académie de Sciences, de l'Institut de France, Paris 23: 399–536. https://doi.org/10.5962/bhl.title.60463

Flores-Villela O, Canseco-Márquez L, Ochoa-Ochoa LM (2010) Geographic distribution and conservation of the Mexican Central Highlands herpetofauna. In: Wilson LD, Townsend JH, Johnson JD (Eds) Conservation of Mesoamerican Amphibians and Reptiles. Eagle Mountain Publishing, Eagle Mountain, 303–321.

Frost DR (2019) Amphibian Species of the World: an Online Reference. Version 6.0. American Museum of Natural History, New York. http://research .amnh.org/herpetology/amphibia/index.html [Accessed on 29 November 2019]

García E, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) (1998). "Climas (Clasificación de Köppen, modificado por García)". Escala 1:1 000 000. México.

INEGI (2016) Conjunto de Datos Vectoriales de Uso de Suelo y Vegetación. Escala 1:250 000. Serie VI (Capa Unión), escala: 1:250 000. edición: 1. Instituto Nacional de Estadística y Geografía. Aguascalientes, México.

INEGI (2017) Anuario estadístico y geográfico del estado de México 2017 / Instituto Nacional de Estadística y Geografía. México: INEGI.

INEGI (2018) 'Áreas Geoestadísticas Estatales', escala: 1:250000. edición: 1. Instituto Nacional de Estadística y Geografía. Aguascalientes, México.

IUCN (2019) IUCN Red List of Threatened Species, Version 2019.2. [Downloaded on 19 November 2019]

Johnson JD, Mata-Silva V, Wilson LD (2015) A conservation reassessment of the Central American herpetofauna based on the EVS measure. Amphibian & Reptile Conservation 9: 1–94.

Kennicott R (1859) Reptiles of the Boundary (Vol. 2, pt. 2.), United States and Mexican Boundary Survey. U.S. 34th Congress, 1st Session, Executive Document (108). 23, plate 21, Figure 2.

Lara-Góngora G (2003) A new cryptic species of *Pseudoeurycea* (Amphibia: Caudata: Plethodontidae) of the *leprosa* group from central México. Bulletin of the Maryland Herpetological Society 39: 21–52.

Lemos-Espinal JA, Dixon JR (2016) Anfibios y Reptiles de Hidalgo / Amphibians and Reptiles of Hidalgo. CONABIO, México, 63 pp. https://doi.org/10.3897/zookeys.594.8289

Lemos-Espinal JA, Smith GR (2015) Amphibians and Reptiles of the State of Hidalgo, México. Check List 11(3): 1–1642. https://doi.org/10.15560/11.3.1642

Lemos-Espinal JA, Smith GR (2020) A conservation checklist of the herpetofauna of Morelos, with comparisons with adjoining states. ZooKeys 941: 121–144. https://doi.org/10.3897/zookeys.941.52011

Lemos-Espinal JA, Smith GR (in press) A conservation checklist of the amphibians and reptiles of Mexico City, with comparisons with adjoining states. Zookeys.

López-Cano R, Becerril-Zepeda G, Benítez C, Cuevas-Solórzano S (2009) El Medio Físico, Biológico y Social. En: Gobierno del Estado de México (Ed.) La Diversidad Biológica del Estado de México. Estudio de Estado. Biblioteca Mexiquense del Estado, Colección Mayor. Gobierno del Estado de México, 49–61.

Lynch JF, Wake DB, Yang S-Y (1983) Genic and morphological differentiation in Mexican *Pseudoeurycea* (Caudata: Plethodontidae). Copeia 1983: 884–894. https://doi.org/10.2307/1445090

Matias-Ferrer N, Murillo S (2004a) *Ambystoma ordinarium*. Herpetological Review 35: 182–183.

Matias-Ferrer N, Murillo S (2004b) *Crotalus atrox*. Herpetological Review 35: 1–190.

Matias-Ferrer N, Murillo S (2004c) *Conophis vittatus*. Herpetological Review 35: 1–190.

Palacios-Aguilar RI, Flores-Villela O (2018) An updated checklist of the herpetofauna from Guerrero, Mexico. Zootaxa 4422(1): 1–24. https://doi.org/10.11646/zootaxa.4422.1.1

Raxworthy CJ, Ananjeva N, Orlov NC (2012) Complete species inventories. In: McDiarmid RW, Foster MS, Guyer C, Gibbons JW, Chernoff N (Eds) Reptile Biodiversity: Standard Methods for Inventory and Monitoring. University of California Press, Berkeley, 209–215.

Rodríguez Romero L, Pacheco L, Zavala Hurtado JA (2008) Pteridifitas indicadoras de alteracion ambiental en el bosque templado de San Jeronimo Amanalco, Texcoco, México. Revista de Biologia Tropical 56: 641–656. https://doi.org/10.15517/rbt.v56i2.5614

Sánchez-Jasso M, Aguilar-Miguel X, Medina-Castro JP, Sierra-Domínguez G (2013) Riqueza especifica de vertebratos en un bosque reforestado del Parque Nacional Nevado de Toluca, México. Revista Mexicana de Biodiversidad 84: 360–373. https://doi.org/10.7550/rmb.29473

SEMARNAT [Secretaría de Medio Ambiente y Recursos Naturales] (2019) Modificación al anexo normativo III, lista de especies en riesgo de la Norma Oficial Mexicana NOM-059-Ecol-(2010) Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo, publicado el 30 de diciembre del 2010. [14 noviembre 2019] https://www.dof.gob.mx/nota_detalle.php?codigo=5578808&fecha=14/11/2019

Taylor EH (1939) Concerning Mexican salamanders. University of Kansas Science Bulletin 25: 259–313. https://doi.org/10.5962/bhl.part.1703

Taylor EH (1940a) New salamanders from México, with a discussion of certain known forms. University of Kansas Science Bulletin 26: 407–430.

Taylor EH (1940b) A new *Rhyacosiredon* (Caudata) from western México. Herpetologica 1: 171– 176.

Taylor EH (1943) Herpetological novelties from México. University of Kansas Science Bulletin 29: 343–361.

Taylor EH (1944) A new ambystomid salamander from the Plateau Region of México. University of Kansas Science Bulletin 30: 57–61. https://doi.org/10.5962/bhl.part.6502

Taylor EH, Smith HM (1942) The snake genera *Conopsis* and *Toluca*. University of Kansas Science Bulletin 28(15): 325–363.

Uetz P, Hošek J (2019) The Reptile Database. http://www.reptile-database.org [accessed 19 November, 2019]

Wiegmann AFA (1828) Beyträge zur Amphibienkunde. Isis von Oken 21(4): 364–383.

Wilson LD, Johnson JD, Mata-Silva V (2013a) A conservation reassessment of the amphibians of México based on the EVS measure. Amphibian & Reptile Conservation 7(1): 97–127.

Wilson LD, Mata-Silva V, Johnson JD (2013b) A conservation reassessment of the reptiles of México based on the EVS measure. Amphibian & Reptile Conservation 7(1): 1–47.

Woolrich-Piña GA, García-Padilla E, DeSantis DL, Johnson JD, Mata-Silva V, Wilson LD (2017) The herpetofauna of Puebla, México: composition, distribution, and conservation status. Mesoamerican Herpetology 4(4): 791–884.

Zaldívar-Riverón A, Nieto-Montes de Oca A (2002) Variation in the rare lizard *Barisia rudicollis* (Wiegmann) (Anguidae) with description of a new species from Central México. Herpetologica 58(3): 313–326. https://doi.org/10.1655/0018-0831(2002)058[0313:VITRLB]2.0.CO;2

Appendix I

Museum collections included in the VertNet.org database records of the State of Mexico amphibians and reptiles that house specimens of the first record of a species in the State of Mexico.

AMNH	Collection of Herpetology, Herpetology Department, American Museum of Natural History;
CNAR	Colección Nacional de Anfibios y Reptiles, Instituto de Biología, Universidad Nacional Autónoma de México;
ENCB	Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional;
FMNH	Division of Amphibians and Reptiles, Field Museum of Natural History;
MCZ	Collection of Herpetology, Museum of Comparative Zoology, Harvard University Cambridge;
KUNHM	Museum of Natural History, Division of Herpetology, University of Kansas;
MVZ	Museum of Vertebrate Zoology at Berkeley, Herpetological Collection;
MZFC	Museo de Zoología Alfonso L. Herrera, Facultad de Ciencias, UNAM. Colección Herpetológica;
NHM	Natural History Museum, London, Zoological Collection;
TCWC	Collection of Herpetology, Texas Cooperative Wildlife Collection, Texas A&M University;
UCM	Collection of Herpetology, University of Colorado Museum;
UIMNH	University of Illinois Museum of Natural History Amphibian and Reptile Collection;
UMMZ	Collection of Herpetology, Museum of Zoology, University of Michigan Ann Arbor;
USNM	Collection of Herpetology, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution;
UTAMM	Merriam Museum, University of Texas Arlington;
UTEP	Collection of Herpetology, Laboratory of Environmental Biology, Biological Science Department, University of Texas – El Paso.